

# Port Selection Criteria for the Korea-China Train Ferry

Ja-Yeon Lee <sup>#1</sup>, Kyong-Jun Yun <sup>+2</sup>, Su-Han Woo <sup>\*3</sup>

<sup>#</sup>*Department of International Trade and Logistics, Graduate School, Chung-Ang University, Republic of Korea*

<sup>+</sup>*Port & Logistics Division, Seosan City hall, Republic of Korea*

<sup>\*</sup>*Department of International Logistics, Chung-Ang University, Republic of Korea (corresponding author)*

<sup>1</sup>[nature1015@cau.ac.kr](mailto:nature1015@cau.ac.kr), <sup>2</sup>[kjyun@korea.kr](mailto:kjyun@korea.kr), <sup>3</sup>[shwoo@cau.ac.kr](mailto:shwoo@cau.ac.kr)

**Abstract**— The Korea-China Train Ferry can be one option to enter into Eurasia and a meaningful way to extend the route for enterprise logistics and manufacturers of Korea to reach the broader global market along with specific access to China. Under this scenario, this study is designed to look at the progress and status of the Korea-China Train Ferry project as an opportunity for Korea to build a path towards Eurasia and to review factors and opinions to consider in port selection based on in-depth interviews with industry participants and experts. It also aims to discuss ideas for a Korea-China logistics cooperative system. For the train ferry success, agreements between Korea and China are essential to ensure consistency in base ports and customs clearance procedures and long-term preparation should be made in the first phase to build the framework for the Korea-China Train Ferry operation.

**Keywords**— *Eurasia, Train Ferry, Selecting ports, AHP Analysis*

## 1. Introduction

Trade of goods from Europe and Asia accounts for more than 60% of global trade and overall trade between the two continents accounts for more than 10% of total global trade in 2016, indicating the significant roles of the regions in the global economy [1]. Despite the economic interconnectedness between these two continents, they are deemed as two different regions and most trade has been through transportation largely based on maritime transportation. Recently, the two continents began to be perceived as the continent of Eurasia encompassing and connecting Europe and Asia. At the same time more attention is being paid to the economic development of Central Asia, Mongolia, and eastern Russia since these regions serve as a bridge between Europe and Asia. In

response to this emerging trend, major countries in the Eurasian region have initiated ambitious economic development plans such as *One Belt, One Road plan* of China and the *New East Asia Policy* of Russia. In October 2013, South Korea also announced *Eurasia Initiative* as a national policy. In addition, China led the foundation of the Asian Infrastructure Investment Bank (AIIB) in January 2016 to secure financial resources for the One Belt, One Road plan and mobilize infrastructure support development of developing countries in Asia. With the AIIB coming into play, the global infrastructure investment market is being expanded and the focus of the global economy is turning to Eurasia. As China and Japan drive aggressive investment to march into the Eurasia region, South Korea also is under pressure to take proactive position, taking advantage of the possible development of the Eurasian region.

These economic development plans of Eurasian countries generally focus on interconnectivity in transport corridors. However, South Korea is partly confined in connecting directly to the adjacent countries due to the division between South and North Korea. Road transportation is not allowed and the Trans-Korea Railway (TKR) project that was initiated more than a decade ago could not be implemented. In this regard, the Korea-China Train Ferry connection has been considered by local and central governments as an alternative for freight and passengers to more effectively transport between South Korea and countries in Eurasian region. The Korea-China Train Ferry project can be a logistical strategy to develop an alternative transport system responding to growing shipment volume after the Korea-China Free Trade Agreement (FTA). The Train Ferry is benefited from the merits of the low cost of marine transport and the large volume of train transport. However, this project is still controversial since it is argued

that demand for this mode is not sufficient. In fact the ministerial agreement on the Korea-China Train Ferry project in 2002, no significant progress has been made.

With the Korea-China FTA coming into effect, trade between South Korea and China is expected to further increase and this will influence demand for a logistics infrastructure to handle the increased volume. In addition, there are some possible factors that may boost trade within the Eurasian region: economic development of the western China cities, the foundation of the AIIB, and potentials of the Central Asian countries for development. Therefore the logistics transport system using a train ferry between Korea and China needs to be reviewed from a strategic perspective. This study considers a scenario that introduces the Korea-China Train Ferry between Chinese ports such as Dalian and Yantai and Korean ports located in western coastline such as Incheon, Pyungtaek/Dangjin and Seosan/Daesan.

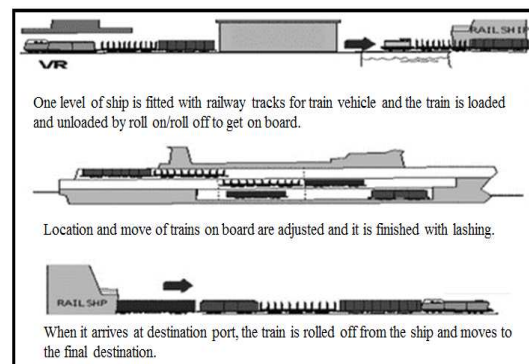
Under this scenario, this study aims at investigating perception of relevant parties on introduction of the train ferry system and port selection criteria for the Korean sample ports using the Analytic Hierarchical Process (AHP). To this end, interviews and survey are conducted with shipping companies, cargo handling companies, forwarders, shippers, and logistics companies as well as with academics and policy makers. The remaining of this paper is structured as follows. Section 2 reviews the existing relevant literature. Section 3 delineates the current status of Korea-China trade and the ferry routes between the two countries and suggests potential train ferry routes. Section 4 presents results from interviews and surveys including AHP results. Section 5 discusses research findings and contribution and limitation of this study.

## 2. Train Ferry System and Relevant Literature

### 2.1. Train Ferry System

The train ferry is a method of multimodal transportation, combining the merits of mass transportation, low cost and the eco-friendly nature of railway transportation with the merits of marine transportation [2]. It enables door-to-door services by reducing time, saving costs, and overcoming

geographical restrictions. The train ferry is equipped with a railway on board of a vessel as large as a container ship to carry freight trains and transport to the destination. It can save logistic costs such as unloading for trans-shipment and it can avoid bottlenecks in the docking process. The train ferry can transport larger or heavier cargo usually not carried by a container [3, 4]. In general, the train ferry is known to be most suitable to link a long-distance inland route (longer than 800 km) and a short-distance sea route (shorter than 300 nautical miles) [3, 4].



**Figure 1.** Conceptual diagram of the Train ferry (Source: Ministry Construction & Transportation, 2003)

### 2.2. Relevant Literature

The beginning of the Korea-China Train Ferry studies is presented in [3, 5]. It is reported that the China Ship Science Research Centre (CSSRC) suggests the railway-maritime multimodal transportation method to connect Incheon-Yantai-TCR in 1996. Following this suggestion, Inha University of Korea and CSSRC propose the routes of Incheon-Yantai/Dalian and Mokpo-Lianyungang for the Korea-China Train Ferry route in the 1998 joint workshop.

A body of literature assesses financial feasibility of the Korea-China Train Ferry projects. In 1999, the Korea Railroad Research Institute (KRRRI) and Inha University conducted a feasibility test on the Korea-China Train Ferry project [3]. A transport route is proposed the Korea-China Train Ferry and assessed financially in [5]. Ref. [8] reviews train ferry status in Europe and surrounding environments in the Trans-China Railway (TCR) in China. The economic feasibility of a container ship

and train ferry to run routes between Korea and China is assessed and compared in [8].

Some studies propose strategies to further develop the train ferry system. A logistics cooperative system among Korea, China, and Japan is proposed using the train ferry routes in [3]. Ref. [9] analyses existing flow of cargo between Korea and China and delved further to build upon the concept that the Korea-China train ferry could be part of the block train that extends to Europe through a transcontinental railway in China. An analytical research on potential users of the train ferry is conducted as one of the alternative transportation options for all of East Asia, including Korea, China, and Japan in [10].

### 3. Status of Korea-China Train Ferry

#### 3.1. Progress of the Korea-China Train Ferry

According to [5, 11], discussion on the Korea-China Train Ferry first started in November 1998 when then President Kim Dae-Jung visited China, signing an agreement on “Korea-China Railway Exchange and Cooperation”. Subsequently in April 2002, the Ministry of Construction and Transportation (as of the writing of this paper, the Ministry of Land, Infrastructure and Transport) of Korea and the Ministry of Railways of China signed an MOU on the “Construction of the Korea-China Train Ferry System”. After the one-year study by the Korea Railroad Research Institute started in 1998, it was selected as the “Construction and Transportation Technology Innovation Initiative.” The initiative was executed as one of the “Key Initiatives” of the Ministry of Construction and Transportation between 2000 and 2003. In assessing the reasons that the train ferry project has yet to be realized, it appears that obstacles to practical approaches due to complicated political issues, as well as controversies over economic analysis, have arisen. The core part of the “Eurasia Initiative” pursued by the Korea government is the plan to build a grand railway (Silk Road Express), starting from Busan, to connect South Korea to the Eurasia continent via North Korea, running on the TKR. Using TCR via North Korea may cut down the distance of transportation to one third of the current route of Pyeongtaek -TCR- Europe in exporting to Europe and save transport costs of more than 30%.

However, the prerequisite to this concept is that North Korea understand potential economic growth from railway use and logistics handling and agree to the construction of the TKR. Unfortunately, as the inter-Korean relationships have soured, the Korean economy seems likely to be isolated, floating like an island at the far-east end of Eurasia, blocked by North Korea. In this situation, the train ferry is the key for South Korea to lift itself out of isolation and to advance into Eurasia via China.

#### 3.2. Trade between Korea and China

With the remarkable emergence of the Chinese economy, trade volume between Korea and China continues to grow. Container port traffic between Korea and China was 5,560,000 TEUs in 2010 and of this volume, trans-shipment accounted for the largest portion of 1,977,000 TEUs (35.6%) and export and import shipment accounted for a similar portion (about 30%) [12]. While 93.7% of container port traffic between Korea and China was handled through the Busan, Incheon, and Pyeongtaek ports in 2010, the similar proportion of the net export/import shipment (3,357,000 TEUs) of 3,582,000 TEUs was handled through these major ports. Figure 3 shows the market share of the major import markets of China. South Korea has been the number one import market for China for three years in a row.

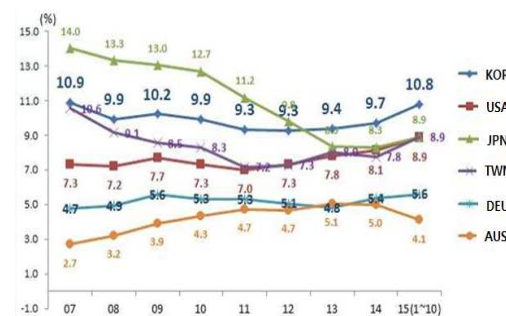


Figure 2. Market share in Chinese import market (Source: Calculated based on CEIC statistics)

#### 3.3. Potential route for the Korea-China Train Ferry

The train ferry has been discussed for introduction between Korea and China. There are three potential ports that can be considered in the Pan Yellow Sea region: Incheon, Pyeongtaek/Dangjin, Seosan. Since Incheon port is equipped with railways, the ports is the only site where a rail ferry terminal could be constructed immediately with an

installation connection facility. With the Kyeongin and the Suin railways capable of being connected to the port, Incheon is the optimal site for the pilot operation. In the long-term, the railway will be extended to the Incheon New Port, so it will be able to accommodate the new rail ferry terminal. At the Pyeongtaek/Dangjin port, when the railway between Pyeongtaek and Poseung is completed by 2019, it can be extended into the Pyeongtaek port and then, after 2020, construction of the rail ferry terminal will be possible. The Seosan/Daesan port in Korea is located closest to the major ports in China. With a deep water and short entry sea route, it allows safe and convenient docking of large vessels. While the port accommodates industrial infrastructure for petrochemical, automobile, and electrical components, the construction plan for entry railway into the Daesan port is being finalized under the third national railway network plan.

Based on the status of the export/import volume between Korea and China and the status of the car ferry operation, feasible routes for the Korea-China Train Ferry are defined in Figure 3. Considering the geographical location, having Incheon, Pyeongtaek/Dangjin, and Seosan/Daesan as base ports, the train ferry sails to Yantai and Dalian ports in China.

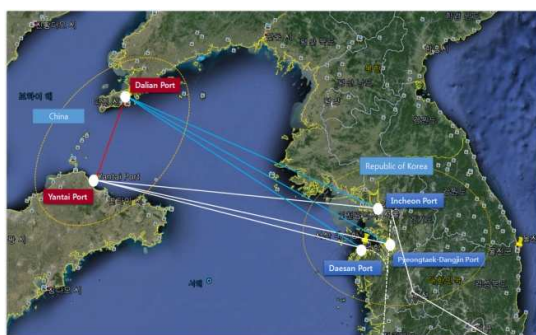


Figure 3. Potential routes for the Korea-China Train Ferry (Mapped by author using Google Us, as of June 7<sup>th</sup> 2016)

## 4. Perception on the Korea-China Train Ferry

### 4.1. Data collection

In order to investigate the perception of stakeholders, surveys and in-depth interviews were conducted. Survey and interview questionnaire comprised the two sections. The first section is about general ideas on the train ferry as shown in Table 1: how positive to the train ferry; the economic impact of the ferry; and the impact of the

AIIB on the introduction to the ferry infrastructure. In addition, answers from the in-depth interviews are summarized. The second section of the questionnaire is pairwise-comparison for AHP. Respondents are managers at shipping companies, cargo handling companies, forwarders, shippers, and logistics companies as well as experts and policy makers. The survey and interviews were conducted over the three weeks in June 2016. Among 30 respondents, shippers were the largest group with 13 respondents, followed by policy makers and cargo handling companies with five respondents each, logistics companies and shipping companies with three respondents each and last, a forwarder with one respondent. The average working period of respondents are 10.6 years.

### 4.2. General perception

In terms of the questions about the necessity of the train ferry introduction as shown in Table 1, the average score was 3.97 on a five-point Likert scale. As for the economic impact on the Korean economy, the respondents agreed it would have an impact on the economy with the average of 4.03. On the impact of the AIIB kick-off on the train ferry, the respondents perceive there will be positive impact with the average of 3.72.

Summarizing the interviews with stakeholders regarding things to consider in introducing the train ferry, a team head at a logistics company (25 years of experience) said *logistics standardization between the two countries (specification of railway) and improvement in customs clearance were required and in the mid- to long-term, construction of the undersea tunnel was worth considering.*

A staff member working in a port (14 years of experience) said *securing safety for the train ferry and preceding studies were important and the candidate site should be reviewed after ensuring consistency in the relevant legal system between the two countries.* A team head at a logistics company (20 years of experience) said *it should be actively pursued based on the understanding of the importance of logistics efficiency to facilitate Korea-China trade and maximize the benefits of the FTA.*

Table 1. Results of survey and interviews

Question	Mean	Interview summary
Necessity of the train ferry	3.97	1.Shorten loading time at ports, direct transport from departure to destination, transport in the shortest route, job creation 2. Diversification in logistics, efficiency improvement, saving logistics cost 3. Chance to adopt advanced new logistics system
Impact on Korean economy	4.03	1.Job creation 2.Economic impact from growth in export/import 3.Reduction in export/import cost with streamlined transport procedures
Impact of the AIIB on train ferry introduction	3.72	1.Economic impact expected on relations between Korea and China from AIIB launch and infra. project in One Belt, One Road policy of China 2.As it is launched for infra. investment, it is expected to give economic boost

### 4.3. Relative importance of selection criteria

Criteria in selecting ports for the Korea-China Train Ferry were analyzed using AHP and the relative importance of these factors were calculated as shown in Table 2. Relative importance was first assessed for main criteria: *port and additional facilities*, *connectivity to transportation*, and *legal/systematic support*, and, subsequently, sub-level criteria were evaluated. For the main criteria, *transportation connectivity* (0.444) and *legal/systemic supports* (0.349) were evaluated more important than *port facilities* (0.207). For the sub-level criteria, *construction and upgrade of railway* was evaluated the most important in the criterion of *transportation connectivity*; *consistency in legal/regulatory system* in the criteria of *legal/systemic support*; and *vessels to accommodate weight of train* in the criterion of *port and additional facilities*.

Combining the relative importance of the main and sub-level criteria, *construction and upgrade of the railway* (0.185), *forecast of cargo demand* (0.141) and *consistency in legal and regulatory system* (0.125) were evaluated significant in the selection criteria.

In contrast, *improvement in customs clearance* (0.055) and *incentives for shipment* (0.054) were less important whereas the provision of incentives is usually required by local governments.

### 5. Conclusion

This study examined perception of stakeholders on the Korea-China Train Ferry focusing on port selection criteria under a scenario. Interviews and surveys were undertaken with practitioners,

academics and policy-makers. It is suggested that, for the sake of the success of the train ferry, agreements between Korea and China are essential to ensure consistency in base ports and customs clearance procedures and long-term preparation should be made in the first phase to build the framework for the Korea-China Train Ferry operation. In addition, if the Korea-China Train Ferry begins operations, in the short term, it should be focused on shipments between Korea and West China and in the long term, the Train Ferry route can be extended to Central Asia and even to Mongolia, using TCR.

In the ever-changing global economic environment, in particular, driven by the Eurasia region, with a focus on a logistics system upgrade across land, oceans, and air, as seen in One Belt, One Road policy, Korea also needs to embark on research on three potential ports (Incheon, Pyeongtaek/Dangjin, Seosan) to make sure they can serve as base ports for the train ferry in the Pan Yellow Sea region as a channel to march into Eurasia.

For the Korea-China Train Ferry, instead of focusing on a short-term outcome or cargo traffic forecast, a longer-term approach is required that examines it as a channel to advance into the Eurasia region. Rather than remaining as a channel solely for trade with China, it should be reviewed and grown in line with infrastructure investment for Central Asia after the launch of the AIIB and China's One Belt, One Road policy.



Table 2. Comprehensive weighted values of major and sub factors for evaluation

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Major Criteria			Sub-level criteria			Weighted value	Final rank
Factor	Weight	Rank	Sub Factor	Weight	Factor		
Ports and additional facilities	0.207	3	Entry railway	0.275	3	0.057	8
			Berth facilities	0.319	2	0.066	7
			Securing vessels to accommodate weight of trains	0.406	1	0.084	6
Transportation connectivity	0.444	1	Extension of network into inland	0.267	3	0.119	4
			Cargo demand forecast	0.317	2	0.141	2
			Construction and upgrade of railway	0.416	1	0.185	1
Legal/ systematic support	0.349	2	Improvement in customs clearance	0.159	3	0.055	9
			Incentives for shipment	0.155	4	0.054	10
			Close cooperation between the two countries	0.328	2	0.114	5
			Ensuring consistency in legal/regulatory system	0.358	1	0.125	3
Consistency ratio: Major factors (0.07), Ports and additional facilities (0.00916), Transportation connectivity (0.02), Legal/systematic support (0.02)							

This study has some limitations in that the sample size is rather small with selected companies and industry experts on the ports of the Pan Yellow Sea region. Thus, further research can be considered in balance between qualitative and quantitative method with larger sample. Despite this limitation, it is expected that the study contribute to a better understanding of the status and progress of the Korea-China Train Ferry to assist in the introduction of the ferry in the future.

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